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GREEN-LOG

DELIVERABLE

D1.3 – Assessment, Transferability and Adaptability Framework Initial Version

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Executive Summary

This deliverable (D1.3) introduces the impact assessment framework and transferability mechanism of GREEN-LOG solutions, as well as the overall process of their establishment. This deliverable is meant to be applied for the evaluation of impacts generated through the GREEN-LOG living labs' trials (Task 4.7) of city logistic solutions including automation, consumer integration, consolidation, stakeholder collaboration and public transport utilization. The first iteration of the structure and components of the integrated assessment framework as well as the Transferability and Adaptability framework that is developed in the GREEN-LOG project is described in the current deliverable (D1.3) while the second and its final version will be reported in D1.5 (to be submitted in Month 33).

The city logistics impact assessment framework consists of the main impact categories and sub-categories, key performance indicators (KPIs) and measurement methodology. The latter (measurement methodology) includes a literature review of previous European projects, a survey with Living Lab (LL) stakeholders, a consultation with technical partners, and a workshop with the LL cities. Through this literature review and input from LL stakeholders, three main impact categories and nine associated subcategories were emerged. They are as follows: (1) Societal, encompassing Governance and People; (2) Environmental, including Pollution, Emission, Energy Consumption, and Land Use; and (3) Economic, covering Local Businesses, Logistics Service Providers (LSPs), and Consumers. Based on the impact categories and sub-categories, twenty (20) KPIs have been established. A questionnaire regarding the importance of each proposed KPI was conducted by different stakeholders from each LL city, in which the relevance and importance of the KPIs were validated by them. Through consultation with partners in Task 4.7 (Moby and University of Halmstad), an impact assessment framework consisting of 4 methodologies is set up to report on the KPIs: direct data, survey, simulation, and qualitative evaluation methods. Finally, through a workshop with all LL cities, case-specific measurements of KPIs for different LL cities are identified with input from the representatives from LL cities.

For the transferability and adaptability mechanism, a literature review of relevant EU projects is conducted to form a 5-step approach to enable the solution transferability for follower cities. As a result, a city characteristic-impact transferability mechanism is established, which includes: (1) Categorizing GREEN-LOG solutions of each LL city based on the focuses of each solution; (2) Identifying the characteristics of LL cities that are related to the effectiveness of GREEN-LOG solutions (e.g. urban density, urban forms, urban freight market profile, economic growth, etc.); (3) Summarising the levels of impact of each solution under different city characteristics; (4) Analysing each follower city's characteristics; and (5) Evaluating the expected impacts of each GREEN-LOG solution for each follower city.

The methodological approach conducted in Task 1.5 and presented in this deliverable will be applied in Task 4.7 to measure the impact of GREEN-LOG solutions to pilot areas, as well as to assess the adaptability and transferability of the demonstrated solutions in other contexts based on the data collection process in Task 4.1.

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Definitions, Acronyms and Abbreviations

Acronym/Abbreviation	Title
GHG	Greenhouse gas
KPI	Key performance indicator
LaaS	Logistics-as-a-Service
LL	Living Lab
LSP	Logistics service provider
VKM	Vehicle kilometers traveled
IR	Internal Reviewers

1.Introduction

1.1 Objectives

The aim of this deliverable is to present the general frameworks and mechanism to evaluate (a) the impacts and (b) the transferability of the GREEN-LOG solutions in the Living Lab (LL) cities of Athens, Ispra, Oxford, Barcelona, and the region of Flanders (with three cities: Ghent, Mechelen, and Leuven). On the one hand, the impact assessment framework has been developed to evaluate the impacts of the various GREEN-LOG solutions. It consists of the KPIs (Key Performance Indicators), the methodology to calculate those and the associated required datasets for its development. On the other hand, the transferability and adaptability framework will be used for assessing the level of impact of the GREEN-LOG solutions on the follower cities (Arad, Helsingborg and Valga) and describing the methodology to do so.

The main objective of Task 1.5 is to develop the last-mile logistics solution assessment framework that entails the complexity of stakeholder engagement, business models' establishment, and operational sustainability in city logistics. This framework is not only meant to be applied to the LL cities' cases provided by the GREEN-LOG project but also set to be used in a broader range of last-mile logistics solutions (e.g. technological, legal, cooperative, etc.). The transferability and adaptability framework has been developed to evaluate how easily can the follower cities adopt the GREEN-LOG last-mile logistic solutions and to facilitate these solutions as best practices for considerations at the regional, national, and European level. Moreover, the adaptability of this framework will refer to each LL city's case (e.g., cities' profiles and characteristics), objectives, and the implementation process of each solution. It will also incorporate the outputs from the impact assessment of GREEN-LOG for evaluating the level of impact that could be generated, thus offering guidance to follower cities to implement a particular solution.

1.2 Document Structure

This document consists of 4 sections. It contains the introduction (Section 1), the impact assessment framework (methodology, impact categories and sub-categories, the KPIs, and measurement methodology) in Section 2, and the transferability and adaptability mechanism. Finally, the conclusions are presented in the last section (Section 4).

2. Impact Assessment Framework

2.1 Methodology

The methodology followed for the impact assessment is depicted in Figure 1 below.

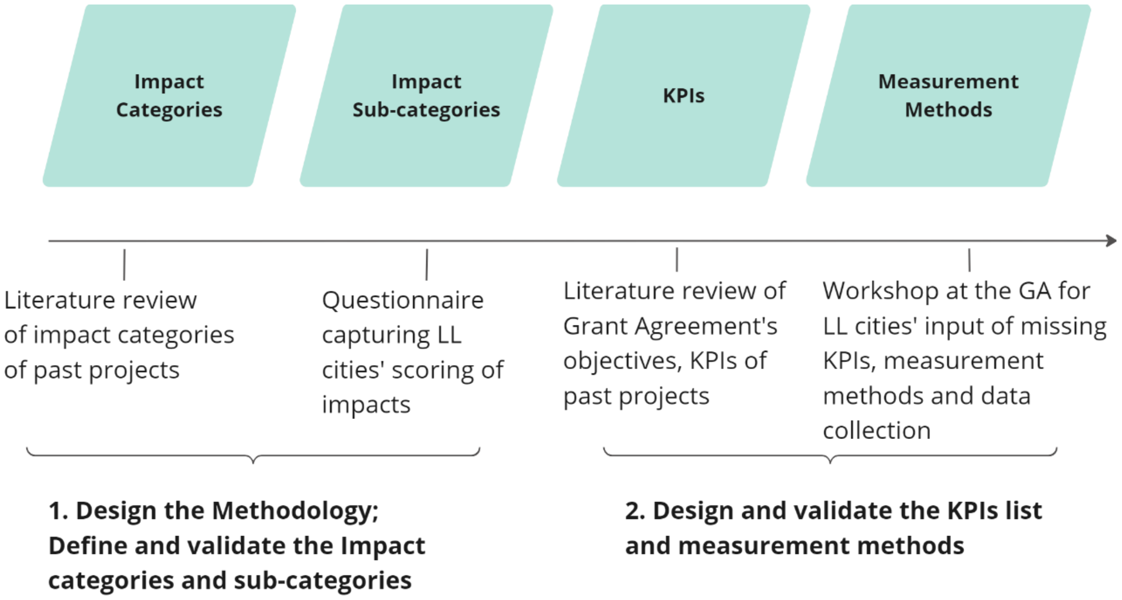

Figure 1 : GREEN-LOG Impact Assessment Framework Formation

The impact assessment framework defines impact categories, their sub-categories, indicators, measurement methods and data sources. Initially, a critical review of previous projects' instruments was conducted in order to establish the GREEN-LOG Impact Assessment Framework. Then, it was further analysed and refined based on the input acquired from GREEN-LOG's key stakeholders, such as the LL cities' perspective on pilots' development and data availability.

The overall process is detailed below:

As GREEN-LOG adheres to the sustainability framework, we measure impacts in all sustainability categories. These impact categories were disaggregated into sub-categories, which were scored in a first evaluation by the LL stakeholders in the individual workshops. Next, the initial list of KPIs as presented in the Grant Agreement was supplemented and detailed through (i) a literature review of the KPIs from the projects CIVITAS and NOVELOG and (ii) alignment with the sister projects URBANE and DECARBOMILE. After the KPI list was finalised, the measurement methods were designed respectively. The KPIs and measurement methods were then validated in the evaluation by GREEN-LOG LL partners and technical partners in a workshop held at the 4th General Assembly meeting in M13 (January 2024). Moreover, the measurement methods that are case-specific for different LL cities were also supplemented at this workshop. Finally, the complete impact assessment framework has been developed. The analysis of the methodological steps/elements to construct/formulate the GREEN-LOG Impact Assessment Framework is presented in the following sub-sections.

2.1.1 Desk Research - Literature Review

A literature review of previous projects on related topics (i.e. sustainable city logistics solutions) was conducted regarding the process and methodology of forming the impact assessment framework. The introduction of several projects and networks that are researched upon is summarised below:

A) ULaaDS (ULaaDs, 2021)

The objective of the ULaaDS project is to revolutionise urban logistics for sustainable cities through innovative technology, collaborative schemes, and policy interventions. It has developed the impact assessment framework for integrating sustainable logistics into urban mobility plans, fostering collaboration among stakeholders. The impact assessment methodology involves multiple perspectives and criteria, identifying societal and business model impacts across various domains: environment, land-use, traffic conditions, logistics efficiency, economic impacts, user experience and acceptance and awareness. (UlaaDs, 2021)

B) NOVELOG (NOVELOG, 2020)

NOVELOG aimed to enhance understanding of urban freight distribution and provide guidance for sustainable policies. Its impact assessment framework for city logistics measures focuses on addressing stakeholder interests and business complexities. The NOVELOG impact assessment framework, structured as multi-criteria decision making, includes modules for impact assessment, social cost-benefit analysis, transferability, adaptability, and risk analysis. It integrates behavioural modeling to support qualitative data collection and measure potential behavioural changes. (NOVELOG, 2020)

C) LEAD (LEAD, 2024)

The LEAD project aims to develop and implement cost-effective sustainable city logistics systems through stakeholder involvement in co-designing last-mile solutions. It will design simulation-based impact assessment tools and a Digital Twin Model to evaluate city logistics strategies and support data-driven decision-making. The project also aims to validate its concepts and tools in six diverse cities, demonstrating their effectiveness in various urban and logistical contexts. A roadmap will also be established based on Living Lab experiences to promote zero-emission city logistics, engage stakeholders, and provide practical guidelines for integrating LEAD tools and Digital Twins into urban mobility planning processes. (LEAD, 2024)

D) CIVITAS (CIVITAS, 2017)

The CIVITAS initiative aims to achieve sustainable and intelligent urban mobility across Europe and globally. Through Living Lab projects, CIVITAS fosters the implementation of diverse sustainable urban mobility measures and research endeavours. Key thematic areas include urban logistics, behavioural change and mobility management, clean and energy-efficient vehicles, demand and urban space management, public participation and co-creation, and road safety and security, which are essential areas to assess the impact of living lab trials in urban transport. (CIVITAS, 2017)

From the ULaaDS project, the impact category and sub-categories of urban freight are proposed upon the subjects of environmental, societal and economic impacts, and the KPIs are further detailed under these categories. From the NOVELOG project, the LEAD and CIVITAS networks, crucial KPIs that assess the effectiveness of urban freight solutions and their measurement methods were studied. Based on the desk research conducted, the impact categories and sub-categories of the impact assessment framework are established.

2.1.2 Questionnaire

To gather LL partners' perspectives on the impact categories, sub-categories and initial associated KPIs, a questionnaire was conducted during individual co-creation workshop in each LL city with their stakeholders including Logistic Service Providers, local shop owners, consumers, citizens, etc. (these activities are carried out as an objective of Task 1.3 and have been reported in D1.2). The survey was designed for all stakeholders to score the importance of the KPIs in terms of measuring the impacts of their LL pilots. A Likert scale of 1-5 (1 meaning very unimportant, 5 meaning very important) was applied for the scoring of each KPI, and the perceived importance of all KPIs from the identified categories were then ranked to see each LL's focuses. The scores are also used to evaluate whether the KPIs are perceived worth of evaluating (whether it receives a high average score from all stakeholders).

2.1.3 KPI and Measurement Methods Formation

A final KPI list has been established through further reviewing the impact categories and sub-categories that have been established, as well as LL cities' input on how important each KPI they perceive. The KPI list includes all indicators that are meant to be measured and their measurement methods. A supplementary KPIs analysis was conducted, and KPI list has been completed to ensure alignment with the objectives of the GREEN-LOG Grant Agreement. Besides, a meeting with technical partners responsible for the evaluation of KPIs was conducted to gain validation for the measurement methods in terms of quantitative or qualitative assessment and data availability.

2.1.4 Impact Assessment Framework Validation

After establishing the impact category, impact sub-categories, KPIs and measurement methods, a workshop with GREEN-LOG LL partners and technical partners was held in the 4th General Assembly in M13 (January 2024). During the workshop, the LL partners and technical partners were required to go through the finalised KPIs and their corresponding measurement methods to evaluate if they are feasible (e.g. whether the required data will be available, and the measures will be feasible). The LL partners were also asked to provide information on supplementary measurement in their own cases. The results and inputs were then organized for the finalization of the GREEN-LOG impact assessment framework.

2.2 Impact Categories and Sub-Categories

As GREEN-LOG adheres to the sustainability framework, we will measure impacts across three categories based on the literature review conducted: (1) Societal, (2) Environmental, and (3) Economic. Under each category, several sub-categories are defined to further detail the structure of the framework. In more detail the (1) societal category encompasses (a) governance and (b) people; (2) the environmental contains (a) pollution, (b) emission, (c) energy consumption, and (d) land use; as well as (3) the economic category covers (a) local businesses, (b) LSPs, and (c) Consumers. A schematic representation of this structure can be found in Figure 2.

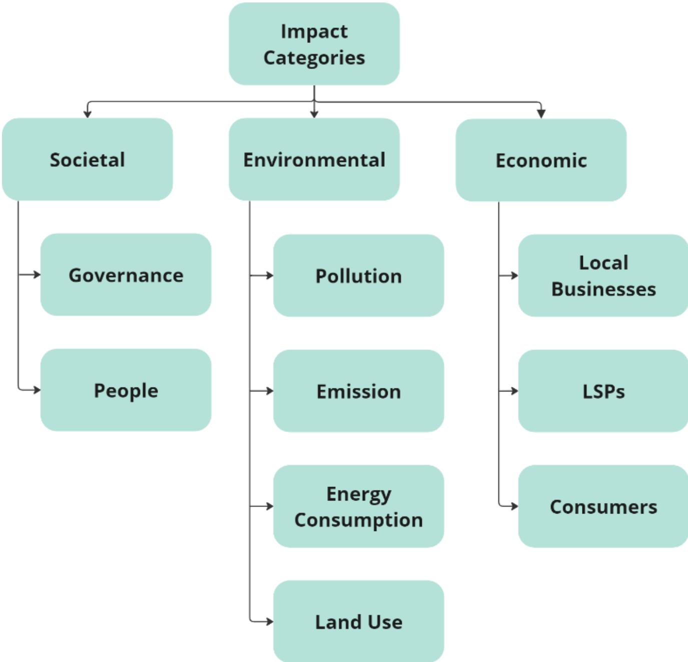

Figure 2: Impact Categories and Sub-categories

The societal category mainly contains impacts on the city authorities' governance issues and impacts on citizens' living quality and awareness improvement. One other important aspect is the public safety issue which results from the road risks caused by urban logistics activities. The environmental category focuses on the impacts of pollution reduction, emission reduction, and energy consumption reduction. What has also been added to the category is the land use of urban logistics activities in which city authorities considered crucial in evaluating the traffic and livability of the cities. The economic category entails the beneficial impacts on local businesses, Logistics service providers (LSPs), and consumers.

The impact categories are described in Table 1.

Table 1: Description of Impact Categories and Sub-categories

Impact Categories	Sub-Categories	Description
Societal	Societal–Governance	This subcategory considers the impact on the regulatory efforts from governmental authorities in improving the sustainability of society as a whole. City authorities should consider the impacts of implementing sustainable urban freight solutions from a broader perspective: How does it reshape society's profile? What issues are meant to be solved for society as a whole? First, new urban freight solutions are expected to create jobs with better qualities for local businesses or logistics service providers. The labour market of urban freight needs regulatory attention regarding the sustainability of operations and processes. The new jobs created are expected to be in line with the sustainability improvement of urban freight transport brought by the solutions. Second, societal issues resulting from urban freight activities, such as congestion and road collisions, require

		regulatory efforts from city authorities. The mitigation of congestion and improvements of the safety level in the areas of the pilots should be evaluated.
	Societal–People	The implementation of sustainable urban freight solutions requires the support of citizens, as new policies involve the use of public funds and changes in public daily lives. Therefore, city authorities are responsible for improving their citizens' awareness and acceptance of sustainable urban freight solutions during the process, especially the residents within the pilot areas. On the other hand, the changes brought by the implementation of new urban freight solutions, such as limitations on driving and parcel pick-ups, will influence the overall life quality of residents in the pilot areas. Therefore, the impacts on citizens' acceptance of the solutions and life-quality changes brought by the solutions are crucial for the evaluation of the people side of the societal impacts.
Environmental	Environmental – Pollution	Urban freight flows generate air pollution and noise pollution that jeopardize the life quality and health of the local citizens, which makes pollution reduction a vital aspect to be evaluated upon the implementation of sustainable urban freight solutions.
	Environmental – Emission	The GHG (Greenhouse Gas) emission is a major cause of global warming and climate change. The reduction of CO2 emission in the last mile is expected to be one of the main focuses of the environmental impacts of sustainable urban freight solutions.
	Environmental – Energy Consumption	Energy consumption is closely relevant to the type of vehicles and VKM (vehicle kilometers traveled) of urban freight activities. Consumption of traditional energy like diesel fuel directly contributes to climate change issues. Therefore, the amount of energy consumption reduction should be evaluated upon the implementation of the sustainable urban freight solutions.
	Environmental – Land Use	Land use of urban freight facilities, such as the establishment of urban consolidation centers and freight parking, could influence the traffic and livability of the cities. The square meters necessary for urban freight facilities, which partly depends on the size of the urban delivery vehicles, should be evaluated through the adoption of sustainable urban freight solutions.
Economic	Economic – Local Businesses	The urban freight solutions are expected to bring benefits to local businesses that are users of urban logistics services (retailers, hotels, restaurant, cafes, etc..). Whether e-commerce delivery, food delivery or waste collection, the prices of last-mile services paid by local businesses should be lowered with more sustainable urban delivery solutions that consolidate demand. This price decrease should not be realized by externalizing part of the costs.
	Economic – LSPs	LSPs have been struggling to achieve operational efficiencies while maintaining sustainability, as last-mile

		operations are both costly and complex. Urban freight solutions should benefit the LSPs in overall cost reduction and vehicle capacity utilization of the last mile. At the same time, LSPs should also be incentivized to adopt more sustainable and greener delivery modes in consideration of the environmental impacts from traditional delivery modes. Urban freight solutions should be evaluated for the economic impact on LSPs with the above aspects.
	Economic – Consumers	The economic impact of urban freight solutions should also include consumers' satisfaction level with last-mile services. Aspects such as delivery price, timeliness, and reliability should be improved with the implementation of sustainable urban freight solutions. This is especially relevant in the LaaS (Logistics as a Service) concept.

Figure 3 shows the connections between the impact categories, sub-categories and the indicators.

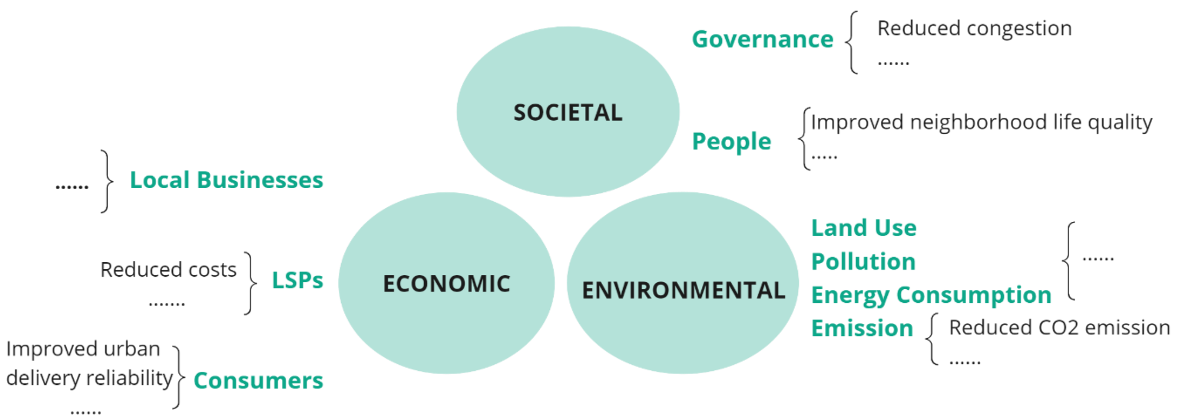

Figure 3: The Impact Categories, Sub-categories and Indicators

2.3 The Key Performance Indicators (KPIs)

After setting up the impact categories and sub-categories, the individual KPIs are designed accordingly. The primary KPI list is based on the KPIs included in the GREEN-LOG Grant Agreement, which has been set to measure the impacts of the urban delivery solutions that will be demonstrated in each LL city. The KPIs are meant to compare the impacts of the GREEN-LOG urban delivery solutions with the business-as-usual scenarios, and the KPIs should be aggregated into a single index for potential compatibility assessment among different cases and scenarios.

Based on the literature review that has been conducted to define the impact categories and sub-categories, the original KPI list is expanded with input from other European projects (ULaaDs, LEAD, Novelog and CIVITAS) with similar objectives. For example, from the ULaaDs Project, citizens' awareness of urban delivery solutions and citizens' acceptance of newly implemented urban delivery solutions are considered important indicators in its impact assessment framework. Therefore, these two indicators are added to the initial GREEN-LOG KPI list.

The initial list of KPIs can be found in Table 2.

Table 2: The Initial KPI list

Impact Category	KPI No.	KPIs
1.Societal	1.1	Job opportunities created
	1.2	Improved quality of jobs created
	1.3	Reduced congestion
	1.4	Increased public awareness of sustainable urban delivery solutions
	1.5	Acceptance of sustainable urban delivery solutions
	1.6	Improved neighborhood life quality
	1.7	Increased safety
2. Environmental	2.1	Saved energy consumption
	2.2	Reduced CO2 emissions
	2.3	Reduction NOx emissions
	2.4	Reduced particulates
	2.5	Reduced noise pollution
	2.6	Land use (m2 used of the facilities and parking)
3. Economic	3.1	Increased benefits for local businesses
	3.2	Reduced cost of urban logistics services
	3.3	Improved service level of urban logistics
	3.4	Improved utilization of storage space of LSPs' (fill rate of the van)
	3.5	Increased zero-emission delivery modes of LSPs'
	3.6	Reduced urban delivery time
	3.7	Improved urban delivery reliability

What is also taken into consideration is the LL cities' own perspectives on the relevance of different indicators. Within Task 1.3, individual co-creation workshops with each LL city were held to align stakeholders on the conceptualized GREEN-LOG solutions for each city. At the workshops, the expected impacts from each pilot were also discussed with all stakeholders. In order to collect corresponding inputs from all LL cities effectively, a questionnaire for stakeholders' perspectives on the importance, relevance, and level of impact of proposed KPIs was distributed to the stakeholders of each city at each workshop (see Figure 3). In the questionnaire, the LL stakeholders (city authorities, LSPs, local businesses and citizens) were asked to score the different KPIs based on their importance in the LL, and differences in the relative importance among different LLs were observed. For instance, LLs with predominantly private partners (e.g. Ispra, Barcelona), showed higher scoring for the economic indicators such as the prices receivers pay for the deliveries. In the LLs where local authorities are playing an important role (e.g. Oxfordshire, Flanders), KPIs under the environmental category received relatively higher scores, especially the KPI of emission reduction. Whereas in the Athens LL where both public and private stakeholders were engaged in, there is less deviation among the scores for KPIs of all 3 impact categories. Besides, all LLs show a comparatively lower preference for the societal indicators, especially KPIs in the societal-governance sub-category such as the creation of jobs. Figure 4 below shows the results of the average scores from stakeholders of all LL cities' scoring of the KPIs.

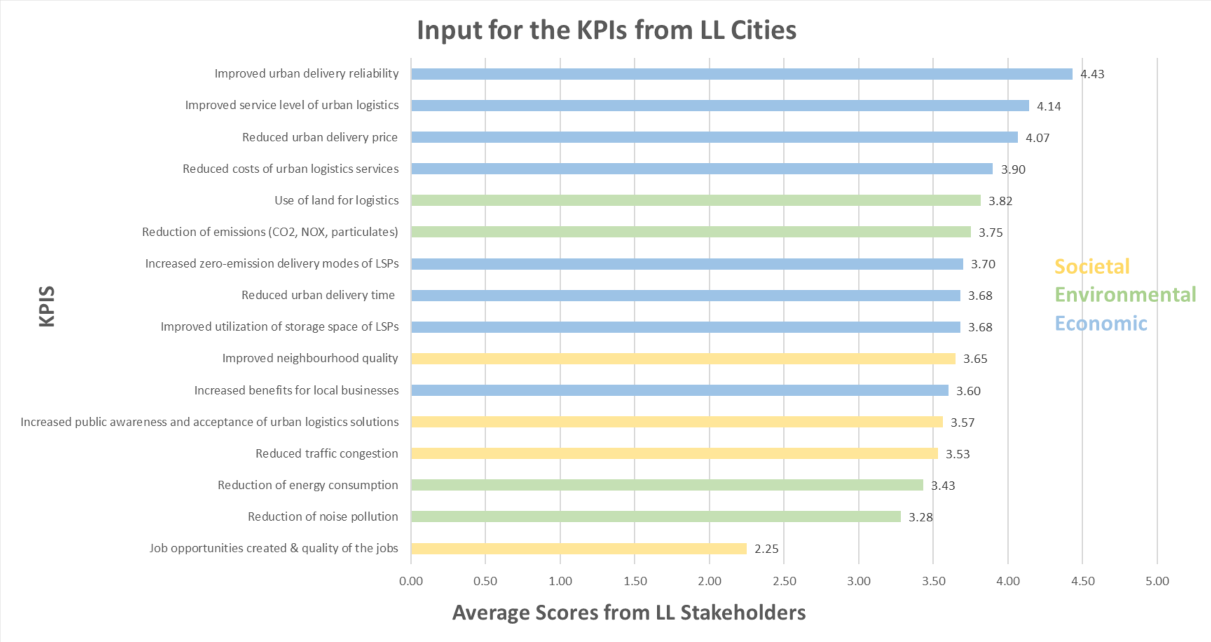

Figure 4: Input for the KPIs from LL Cities

According to the average scores shown, almost all KPIs included in the questionnaire received relatively high scores (>3 out of 5) from stakeholders, including the KPIs added later based on the literature review of other European projects. The KPIs are therefore validated by the LL cities.

2.4 Measurement Methodology

The measurement methods are formed through three steps:

First, defining the data source for the measurement of KPIs: two main approaches for the measurement of the KPIs are determined as (1) measured via empirical results from the LL pilots (e.g. comparing before-after scenarios), and (2) calculated via the GREEN-LOG augmented intelligence modeling platform where simulation will be performed for quantitative KPIs. The quantitative KPIs that are available and suitable to be calculated through simulation via the GREEN-LOG platform are first determined. The approaches for qualitative KPIs that are suitable to be measured empirically are also designed depending on the different target groups of each KPI.

Second, conducting a workshop with technical partners: to ensure the general feasibility of the methodology to calculate each KPI, an online workshop with the technical partners who are responsible for the evaluation of the KPIs was conducted. During the workshop, the KPIs that are indicated to be calculated via the GREEN-LOG platform are discussed with the partners responsible for the simulation functionality of the GREEN-LOG platform (T2.4), and the rest of the KPIs measurement methods are discussed with the partners responsible for data management (T5.2) and KPIs evaluation (T4.7).

Third, determining the qualitative evaluation: in collaboration with Task 4.7, the qualitative methodology will be implemented to provide additional evidence when assessing three societal KPIs, namely public awareness, solution acceptance, and life quality.
Through the three steps, the basic feasibility of measurement methodology has been agreed upon and confirmed by the technical partners and includes the following:

- Simulation
- Survey Analysis
- Direct Data
- Qualitative Evaluation

As a result, the integrated GREEN-LOG impact assessment framework has been established as shown in Table 3.

Table 3: The GREEN-LOG Impact Assessment Framework

Category	KPIs	Measurement	Methodology	General Specification
1. Societal	1.1 Job opportunities created	Total number of jobs created compared to base scenario.	Direct Data	Number of jobs during pilot / Number of jobs before.
	1.2 Improved quality of jobs created	Change on the score of job quality survey.	Survey Analysis	Ordinal score of perceived job quality.
	1.3 Reduced congestion	Change on the average travelled time in the areas of pilots.	Simulation	Time travelled per route.
	1.4 Increased public awareness of sustainable urban delivery solutions	The level of user and broader citizen engagement in the Living Lab settings.	Qualitative Evaluation	Analysis of conducted user studies and citizen engagement activities in LLs.
	1.5 Acceptance of sustainable urban delivery solutions	Percentage of people who show acceptance of the GREEN-LOG solutions / The level of user-centric design & iterative prototyping in the Living Lab settings.	Survey Analysis / Qualitative Evaluation	Appreciation of GREEN-LOG solutions /Analysis of local fieldwork in LL implementation sites (participant observations, co-creative filmmaking.
	1.6 Improved neighborhood life quality	Change on the citizens' satisfaction score of living in the neighborhood compared to base scenario/ The level of user and broader citizen engagement in the Living Lab settings.	Survey Analysis / Qualitative Evaluation	Ordinal score of the citizens' satisfaction of living in the neighborhood of the pilots/ Analysis of potential for long-term improvements through interviews with

				LL stakeholders.
	1.7 Increased safety	Number of urban delivery kms in school zones (morning/evening).	Direct Data	Total number of urban delivery kms in school zones (morning/ evening) compared to base scenario.
2. Environmental	2.1 Saved energy consumption	Percentage of energy consumption reduction.	Calculated based on simulation or marketplace	Energy consumption compared to base scenario.
	2.2 Reduced CO2 emissions	Percentage of CO2 reduction.	Calculated based on simulation or marketplace	CO2 emissions compared to base scenario.
	2.3 Reduction NOx emissions	Percentage of NO2 reduction.	Calculated based on simulation or marketplace	NO2 emissions compared to base scenario.
	2.4 Reduced particulates	Percentage of particulate reduction.	Calculated based on simulation or marketplace	Particulate emissions compared to base scenario.
	2.5 Reduced noise pollution	Percentage of noise reduction.	Calculated based on simulation or marketplace	Noise levels compared to base scenario.
	2.6 Land use (sq used of the facilities)	Percentage of land use reduction (including parking).	Direct Data	m2 of land use change compared to base scenario.
3. Economic	3.1 Increased benefits for local businesses	The change on the price of deliveries paid by the local businesses.	Direct Data	Distribution of prices compared to base scenario.
	3.2 Reduced cost of urban logistics services	The change on the cost of LSPs' compared to base scenario.	Calculated based on simulation or marketplace	Calculating the cost per delivery.
	3.3 Improved service level of urban logistics	The change on the score of consumer satisfaction of urban logistics services.	Survey Analysis	Ordinal score of perceived logistics service.
	3.4 Improved utilization of storage space of LSPs' (fill rate of the van)	The change on the ratio of storage space utilization.	Direct Data	Number of parcels per tour divided by capacity compared to base scenario.

	3.5 Increased zero-emission delivery modes of LSPs'	The change on the number of zero-emission delivery modes used.	Direct Data	Share of VKT conducted by zero-emission vehicle compared to base scenario.
	3.6 Reduced urban delivery time	The change on the average delivery time compared to base scenario.	Direct Data	Questions about time spend per delivery.
	3.7 Improved urban delivery reliability	The change of percentage of on-time deliveries compared to base scenario.	Survey Analysis	Questions about delivery reliability.

The third step was to conduct the workshop with all LL cities' stakeholders to validate both the KPIs list and the measurement methods. This workshop was held at the GREEN-LOG 4th General Assembly meeting at the University of Wolverhampton. The cities were first presented with the preliminary KPIs list and measurement methods shown in Table 4 above. In terms of the KPIs, the cities were requested to:

- Examine if there are any KPI missing for their pilots.
- Evaluate if there are any uncertainties in their role in the KPI evaluation process.
- Evaluate the feasibility of measuring the KPI in their own cases, as in any KPI in which relevant data cannot be collected or specified in their pilots.
- Providing potential risk factors that they are aware of.

Next, the cities were asked to review the proposed measurement method for each KPI. In this step, the cities evaluated both the feasibility of the methods and the availability of the data needed to be collected. Along with cities' input, the technical partners related to the KPIs evaluation requested to provide the same input from their perspectives.

Upon the LL partners input, the KPI measurement specification is developed in Table 4 below. The measurement methods were further defined regarding the goal, the KPIs measured, and responsible partners.

Survey 1: The goal of this survey is to measure the base scenario of KPI 1.2, 3.3 and 3.7.

- Responsible for design: MOBY (T4.7)
- Foreseen execution: M20
- Responsible for implementation: LL leaders

Survey 2: The survey's goal is to measure the evolution in each LL regarding KPI 1.2, 3.3 and 3.7.

- Responsible for design: MOBY (T4.7)
- Foreseen execution: M20
- Responsible for implementation: LL leaders

Simulation: The goal of the measure is to model both base scenarios and pilot evolution results of KPI 1.3, 2.1, 2.2, 2.3, 2.4, 2.5, and 3.2 based on the data provided from the LSPs in every pilot.

- Responsible for design: AIMSUN (T2.4)
- Foreseen execution: This processual evaluation will be executed over the two demonstration periods January 2024 – December 2025
- Responsible for implementation: LL leaders

Direct Data: This measure suits the KPI 1.1, 1.7, 2.6, 3.1, 3.4, 3.5 and 3.6 that are measurable by direct data from LSPs, marketplace, or city authorities.

- Responsible for design: MOBY (T4.7)
- Foreseen execution: M20
- Responsible for implementation: LL leaders

Qualitative Evaluation: KPI 1.4, 1.5 and 1.6. The evaluation will be also based on qualitative assessment of the continuous development processes of the LL implementation sites during the demonstrations. This processual assessment is guided by evidence-based qualitative societal Learning Lab impact criteria that will be explained through an overview of the knowledge base in the field. The method will involve continuous interaction with GREEN-LOG LL core teams (mainly through interviews and workshops) that have been identified in D1.1, and through local fieldwork in LL implementation areas. This means participant observation of user engaging activities organized by LL core teams, interviews, and co-creative activities (for example collaborative video documentation) with LL stakeholders (incl. user communities).

- Responsible for design: MOBY (T4.7)
- Foreseen execution: This processual evaluation will be executed over the two demonstration periods August 2024 – October 2025
- Responsible for implementation: LL leader

Table 4: LL Specification of KPI Measurement

KPI	Athens	Barcelona	Flanders	Ispra	Oxfordshire
1.1 Job opportunities created	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)
1.2 Improved quality of jobs created	Survey 1, Survey 2	Survey 1, Survey 2	Survey 1, Survey 2	Survey 1, Survey 2	Existing survey results from LSPs
1.3 Reduced congestion	Simulation	Simulation	Traffic counts	N.A.	Vehicle counts per certain route
1.4 Increased public awareness of sustainable urban	Qualitative Evaluation	Qualitative Evaluation	Qualitative Evaluation	Qualitative Evaluation	Qualitative Evaluation

delivery solutions					
1.5 Acceptance of sustainable urban delivery solutions	Survey 1, Survey 2 / Qualitative Evaluation	Survey 1, Survey 2 / Qualitative Evaluation	Survey 1, Survey 2 / Qualitative Evaluation	Exisiting survey results from users	Survey 1, Survey 2 / Qualitative Evaluation
1.6 Improved neighborhood life quality	Survey 1, Survey 2 / Qualitative Evaluation	Survey 1, Survey 2 / Qualitative Evaluation	Survey 1, Survey 2 / Qualitative Evaluation	Existing survey results from users	Survey 1, Survey 2 / Qualitative Evaluation
1.7 Increased safety	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)
2.1 Saved energy consumption	Calculation based on simulation results	Calculation based on simulation results	VKT calculated through LaaS marketplace	VKT calculated through LaaS marketplace	Calculation based on simulation results
2.2 Reduced CO2 emissions	Calculation based on simulation results	Calculation based on simulation results	Calucated in LaaS Marketplace	CO2 emission of car travels replaced by 'food delivery' travels	Calculation based on simulation results
2.3 Reduction NOx emissions	Calculation based on simulation results	Calculation based on simulation results	Calculated in LaaS Marketplace	Calculated in LaaS Marketplace	Calculation based on simulation results
2.4 Reduced particulates	Calculation based on simulation results	Calculation based on simulation results	Calculated in LaaS Marketplace	Calculated in LaaS Marketplace	Calculation based on simulation results
2.5 Reduced noise pollution	Calculation based on simulation results	Calculation based on simulation results	Calculated in LaaS Marketplace	Calculated in LaaS Marketplace	Calculation based on simulation results
2.6 Land use (sq used of the facilities)	Direct Data (city authorities)	Direct Data (city authorities)	Direct Data (city authorities)	Direct Data (city authorities)	Direct Data (city authorities)
3.1 Increased benefits for local businesses	Direct Data (marketplace)	Direct Data (marketplace)	Direct Data (marketplace)	Direct Data (marketplace)	Direct Data (marketplace)
3.2 Reduced cost of urban	Simulation	Simulation	Calucated in LaaS Marketplace	Calucated in LaaS Marketplace	Simulation

logistics services					
3.3 Improved service level of urban logistics	Survey 1, Survey 2	Survey 1, Survey 2	Survey 1, Survey 2	Survey 1, Survey 2	Survey 1, Survey 2
3.4 Improved utilization of storage space of LSPs' (fill rate of the van)	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)
3.5 Increased zero-emission delivery modes of LSPs'	Direct Data (LSPs)	Direct Data (LSPs)	Survey for users or calculations through marketplace	Direct Data (LSPs)	Direct Data (LSPs)
3.6 Reduced urban delivery time	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)	Direct Data (LSPs)
3.7 Improved urban delivery reliability	Survey 1, Survey 2	Survey 1, Survey 2	Survey 1, Survey 2	Survey 1, Survey 2	Survey 1, Survey 2

3. Transferability and Adaptability Mechanism

This section provides a first conceptualization of the transferability and adaptability framework of GREEN-LOG. The final framework will be based on the results of the LLs and will be part of deliverable 1.5 (M33).

The proposed framework relies on synergy and collaboration, where cities collaborate as LLs to leverage each other's strengths and insights. By creating a synergistic environment, GREEN-LOG aims to tackle more complex challenges collectively, develop innovative solutions, and share resources efficiently. The principle of knowledge exchange is pivotal. Each LL benefits from shared experiences, lessons learned, and best practices from other labs. This ongoing exchange not only strengthens each city's capabilities but also prevents the repetition of past mistakes and accelerates the pace of innovation.

Lastly, the transferability and adaptability mechanism rely on the expected output of the impact assessment of GREEN-LOG solutions, in which the integrated impact of a solution – in relation to the city's characteristics - will be quantified. Linking this to the characteristics of follower-cities allows for assessing the transferability and adaptability of the GREEN-LOG solutions.

To build up the transferability process on top of the impact index, a literature review of the NOVELOG (2020) project's transferability tool was conducted. NOVELOG's transferability tool kit (NOVELOG, 2024) works upon data input of a city's problems and objectives, morphology and business profile, stakeholder category and policy implementation focus. The solutions of the pilot cities whose parameters match the data input will be filtered, and the impacts of the particular solutions demonstrated in LL cities will also be presented (NOVELOG, 2024). However, the transferability analysis only ranks suggested solutions by indicating the match rate of city criteria but does not evaluate to what extent and how much impact could be expected from the filtered solutions for the cities that use the transferability tool.

To build a transferability framework that measures the levels of impacts of GREEN-LOG solutions on follower cities, the following steps should be taken:

1. Categorizing GREEN-LOG solutions of each LL city based on the focuses of each solution, e.g. consolidation (Athens, Flanders, Barcelona), user integration (Flanders), automation (Oxford, Ispra), etc.
2. Based on the LL cities' characteristics and the components of the GREEN-LOG solutions, city characteristics that are related to the effectiveness of GREEN-LOG solutions (e.g. urban density, economic growth, logistics profile, etc) are identified.
3. Setting up the City Profile-Impact Chart: based on the impact evaluation results of each LL pilot and the city profiles categorized, the levels of impact of each solution under different city characteristics are summarised (see Appendix A.1).
4. Setting up the Follower City's Profile Chart: Analyse each follower city's characteristics according to the city profile parameters (see Appendix A.2).
5. Setting up the Follower City's Impact Chart: According to Table 5 and Table 6, evaluate the expected impacts of each GREEN-LOG solution for each follower city (see Appendix A.3).

4. Conclusion

The Deliverable 1.3 Assessment, Transferability and Adaptability Framework document, which is linked to Task 1.5, introduces the impact assessment framework and transferability mechanism of GREEN-LOG solutions, as well as the overall process of their establishment. An integrated impact assessment framework containing impact categories, impact sub-categories, KPIs, and measurement methods is established. For the transferability and adaptability mechanism, a 5-step approach to enable the solution transferability for follower cities is developed.

This outcome of T1.5 is meant to be applied by the WP4 partners for the evaluation of impacts generated through the living labs' pilot trials (T4.7) based on the data collection process in T2.1. The 1st iteration of the deliverable contains the impact assessment framework, which will be further improved and validated in the 2nd iteration (D1.5-M33) that also contains the developed transferability and adaptability framework of GREEN-LOG solutions.

Reference

Reference	Name of document
[REF-01]	Engels, D., Van Den Bergh G. and Breemersch T. (2017) CIVITAS SATELLITE D2.3 Support Action Towards Evaluation, Learning, Local Innovation, Transfer & Excellence. Refined CIVITAS process and impact evaluation framework. August 2017.
[REF-02]	LEAD. (2024) Retrieved from https://www.leadproject.eu/
[REF-03]	NOVELOG. (2020) Retrieved from http://novelog.eu/
[REF-04]	NOVELOG Toolkit. (2024) Retrieved from https://www.uct.imet.gr/novelog-tools/toolkit
[REF-05]	Ørving, T. and Jensen, S.A. (2021) Framework, methodology and KPI Identification, ULaaDS D5.1: Framework, methodology and KPI identification.

Appendix A - Preliminary Table Templates for the Transferability and Adaptability Mechanism

A.1 Table Template for the City Profile–Impact Chart

	Solution A: Consolidation	Solution B: User Integration	Solution C: Automation	……
Urban density	High density – High impact, Medium density – Medium impact, Low density – Low Impact.	……	……	……
Urban forms	City as a marketplace – High impact, Strictly planned urban form –Low impact ……	……	……	……
Urban freight market	Retail – High impact, Ho-Re-Ca – Low impact ……	……	……	……
Economic growth	……	……	……	……
……	……	……	……	……

A.2 Table Template for the Follower City's Profile Chart

	Urban density	Urban Forms	Economic Growth	……
Follower City 1	High	……	……	……
……	……	……	……	……
……	……	……	……	……

A.3 Table Template for the Follower City's Impact Chart

	Solution A: Consolidation	Solution B: User Integration	Solution C: Automation	……
Follower City 1	High Impact	Medium Impact	……	……
……	……	……	……	……
……	……	……	……	……